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Maine Agricultural Experiment Station

BULLETIN No. 56.

DECEMBER, 1899.

APPLE INSECTS OF MAINE.

This Bulletin gives a description of the more common insect pests of the apple, together with their habits, vulnerable points, and remedies.

Requests for the Bulletins should be addressed to the
AGRICULTURAL EXPERIMENT STATION,
Orono, Maine.



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APPLE INSECTS OF MAINE.

F. L. HARVEY AND W. M. MUNSON.

Specific directions for spraying the apple for insect and fungous pests have been prepared by one of the writers and will be sent, free of cost, on application to the Agricultural Experiment Station, Orono, Maine. The indiscriminate killing of insects should, however, be guarded against, as all are not injurious. Many are parasites upon the injurious species, or at some period devour their eggs or young.

These beneficial insects should be recognized when seen, and should be protected and encouraged. Attention is particularly called to the ichneumon, syrphus and tachina flies, and to the lady birds and ground beetles, illustrated in plate I. The ichneumon flies have four wings and are related to the wasps and bees. There are numerous minute forms which prey upon the eggs and larvæ of injurious insects, and larger forms that deposit their eggs upon the caterpillars. Syrphus and tachina flies are two-winged insects, the former of which, in the larval stage, devour plant lice, and the latter are parasitic upon the larvæ of other species. The lady birds and ground beetles are carnivorous, feeding upon both larvæ and perfect forms of other insects.

In the following pages only the more important insects injurious to the apple are discussed, and methods of treatment suggested.

EXPLANATION OF TERMS.

An insect with a complete life history passes through four stages; viz., egg, larva, chrysalis or pupa, and imago or mature insect. The egg hatches into the larva—i. e. caterpillar, worm, grub, or maggot, as the case may be; the larva, after a time, changes to the pupa or chrysalis, which is the inactive or resting state, and may be naked or enclosed in a cocoon; the pupa, after a longer or shorter period, develops into the imago or perfect insect.

A. INSECTS AFFECTING THE TRUNK AND BRANCHES.

THE ROUND-HEADED APPLE TREE BORER. *Saperda candida*, Fabr.

The round-headed borer was first recorded in 1824 by Thomas Say, but was doubtless a native of America, widely distributed at that time, though unnoticed. While it prefers the apple, it also affects the native crab apple, sugar pear, thorn bush, pear, quince, and roundwood.

Description.

Eggs.—Minute, yellowish white.

Larva.—When full grown about one inch long; footless, yellowish white. Head small, chestnut brown, polished, hornlike; jaws two, black; the second joint large and broad, the next two narrow. Rings of the body (segments), from the fourth to the tenth inclusive, armed on the upper side with two fleshy warts.

Pupa.—Lighter colored than the larva and with transverse rows of minute spines on the back.

Perfect Insect.—A beetle, about three-fourths of an inch long, with two broad white stripes extending from the head to the ends of the wing cases; cinnamon brown above; hoary white below; legs, antennæ and face whitish.

Life History.

The eggs, according to Mr. Chas. Pope, who has gathered hundreds of them, are laid in a short slit, made by the beetle with the ovipositor, in the smooth bark. Sometimes the eggs are laid in the bottom of the slit next to the wood, but generally in an opening made in one side of the slit, half way through the bark. Several eggs, sometimes ten or a dozen, are laid on the same tree, being distributed around the trunk usually within six inches of the ground, but occasionally higher and sometimes at the base of the limbs. They are deposited from June to September, in Maine. The egg soon hatches and the young larva gnaws its way into the inner bark and sap wood. When winter comes the young borer works its way, in the wood, below the surface of the soil. In the spring it ascends and passes the second summer in the sap wood. It spends the second winter below the surface of the soil, as it did the first. The third summer it ascends and bores deep channels in the wood in every direction and finally bores upward and outward, nearly to the bark, lines the cavity with borings and transforms to the pupa. The third

spring it emerges, deposits its eggs, and the cycle of life is complete.

Vulnerable Points and Remedies.

The eggs are laid in the bark, in plain view, and can be readily detected and taken out. The young larvæ are readily located by the flow of sap from the wound they make, and by the chip-pings they push out of the mouth of the borings.

The perfect insect may be prevented from depositing eggs by the application of repellants to the trunk of the tree, e. g., tarred paper, or a mound of earth. Soft soap, or whitewash, applied to the trunk of the tree in June and July, is said to prevent the beetle from laying her eggs on the trees thus protected. The trees should be examined twice each year, in May and September, and the young larvæ removed. Should any escape, and penetrate deeply into the wood, they may be destroyed by probing with a sharp wire.

THE FLAT-HEADED APPLE TREE BORER. *Chrysobothris femorata*, Fabr.

This insect, a native of America, is common in Maine. Besides the apple, it is known to attack the pear, plum and peach, also the oak, box-elder, hickories and maples. The injury attributed to the round-headed borer is often due to it.

Description.

Eggs.—Pale yellow, varied, with one end flattened, irregularly ribbed.

Larva.—Soft, flesh-like, pale yellow; head small, deeply set; jaws black; third segment twice as broad as any of the posterior ones, and bearing on its upper surface a large, oval, callous-like projection, covered with numerous raised brown points.

Pupa.—Lighter colored than the larva and with transverse rows of minute spines on the back and a few at the extremity of the body.

Perfect Insect.—A beetle, variable in size but usually about one-half inch long, oblong-flattish in shape, of a dark, dull greenish color with a coppery reflection; under side and legs brilliant copper color; feet green. On each wing case are two irregularly oblong spots of deeper copper color than the remainder of the wing, dividing the wing cases into three nearly equal portions. The upper surface appears as though sprinkled with an ash-colored powder.

Life History.

The beetle makes its appearance in June or July in our latitude. It loves the light and may frequently be seen about the

orchard on the trees. It is very active and hard to catch, quickly taking wing. It lays, probably, about one hundred eggs.

The female fastens her eggs, singly or in groups, to loose flakes of bark, or in the crevices, by means of a glutinous substance. The eggs soon hatch and the young larvæ gnaw through the bark and live on the sap wood, making flat channels next to the bark, sometimes girdling the trees. As they get older they bore upward into the solid wood and, when ready to change to the chrysalis, gnaw to the bark and nearly through it. They then change to the chrysalis, and in about three weeks the beetles come forth. The larvæ attack the trunk and larger branches and remain in the tree but one year.

Vulnerable Points and Remedies.

Same as for the round-headed borer.

THE OYSTER-SHELL BARK LOUSE. *Mytilaspis pomorum*, Bouché.

The oyster-shell bark louse is a native of Europe and was introduced into this country, on nursery stock, about a hundred years ago. It is widely distributed, and is exceedingly common in Maine. The twigs of apple trees are often literally covered with the scales, causing great injury. Besides doing great damage to apple trees, this scale is found on the pear, plum, cultivated and wild currant, roundwood, dog wood, and several other shrubs and trees.

Description.

Eggs.—White, changing to yellowish or reddish with age, oblong, about .01 inch long; from 20 to 100 under each scale.

Young females.—Wingless, white and about .01 inch in length, move about quickly, appearing on the branches as small white specks which finally attach themselves, by their beaks, to the new shoots, where the scale is perfected.

Scale of female.—Wingless, about .08 of an inch long, narrow, widened at the posterior end, curved and shaped somewhat like an oyster shell. Brown or grayish, closely resembling the bark in color. Most frequently placed with the small end toward the tip of the twig.

Scale of male.—Much smaller than the female, wedge shaped and straight; usually placed on the leaves and rarely seen. The male insect undergoes a complete metamorphosis, and in the perfect form is provided with two wings.

Life History.

The eggs hatch late in May or early in June. If the weather is cold, the lice remain under the scale until warm weather, when they may be seen running about the twigs for a location to attach themselves. The most of these fix themselves around the bases of the side shoots of the twigs, by means of their tiny slender beaks, and live upon the sap of the tree. They gradually undergo changes. Before the close of the season the louse secretes the scale under which it lives and perfects itself. By the middle of August the female becomes a bag of eggs, which are deposited in a mass under the scale, the body of the louse shriveling, as the eggs are laid, until it is a mere speck at the small end of the scale. These eggs remain under the scale, if not destroyed, until the following spring and then hatch, completing the life history.

How this pest is spread from tree to tree is not well made out, but it is supposed that birds carry them on their feet and that large insects may transport them or that the wind may blow the young about. They are probably introduced into young orchards on the nursery stock and multiply.

Remedies.

During the winter examine the twigs and scrape off the scales, after which, wash with a strong solution of caustic soda or washing powder, applied with a stiff brush. In June, while the lice are still active, spray with an alkaline solution, or better, with kerosene emulsion.

There are several natural enemies which help to keep the insect in check. One of the most important of these is a species of mite, which preys upon the louse as well as upon its eggs. This mite is so small as to be seen only with a microscope.

Another important aid in controlling this pest is the twice-stabbed lady-bird. Both larva and perfect beetle devour large numbers of the lice. The mature form of this insect is readily recognized by its polished black wing-cases with a blood-red spot on each.

THE PEAR-BLIGHT BEETLE, OR SHOT-BORER. *Xyleborus pyri*,
Peck=*X. dispar*, Fabr.

This is a native species that attacks hemlock, beech, oak, and cedar, and has transferred its depredations to apple trees in Maine. We have received from several localities specimens of apple limbs that were literally honeycombed with small channels that extended through the laburnum and heart wood to the center. The young larvæ bore into the wood, making deep channels which in small twigs interfere with the circulation of the sap, and the twigs wither, giving the appearance of blight, hence the name pear-blight beetle. The work of this beetle should not, however, be confounded with the pear-blight proper, which is caused by bacteria. The exit holes through the bark were .06 of an inch in diameter and nearly circular, looking like small shot holes. The wood was green, showing that the insect attacks the growing tree. Living wood does not appear to be essential to the life and comfort of this species, for after a period of several weeks we found in a limb that had been in a dry place in a box, young larvæ, full grown larvæ, pupæ, and perfect beetles.

Description.

So far as we know, the eggs have not been described. They must be very small and are said to be laid at the bases of the buds. We have never seen them.

When the larvæ are full grown they transform to pupæ in the burrows, and finally emerge as small beetles about one-tenth of an inch long and of a dark brown or nearly black color, with the antennæ and legs of a rusty red. The thorax is short, very convex, rounded and roughened. The wing covers are marked by longitudinal rows of punctures. The hind part of the body slopes abruptly. The beetles leave their burrows in July and deposit eggs before August.

Remedies.

As the beetles work wholly under the bark they cannot be reached by insecticides. The only way is to watch the trees during the latter part of June and July and, if blighted twigs or diseased limbs are noticed, examine the branches for small pin holes; if found, the presence of this or some related species may be suspected. The diseased limb should at once be cut far enough below the injury to include all the burrows, and burned,

to prevent the beetles emerging and attacking new trees. As these beetles live in forest trees, orchards near timber are more liable to become infested.

THE WOOLLY LOUSE OF THE APPLE. *Schizoneura lanigera*,
Hausm.

Two forms of this insect are recognized by entomologists. One, known as the apple-root plant-louse, attacks the roots, producing wart-like excrescences or swellings. The other form, known as the woolly louse of the apple, is the one found in Maine. It feeds upon the sap of the trunk and branches. The two are regarded as the same species, living under different conditions. The above ground form occurs most abundantly, in this country, in New England. Entomologists differ in their opinions regarding its nativity; some accredit it to America; most are inclined to think it originated in Europe, where it is much more destructive than in this country.

This insect, in the root form, was noticed in this country as early as 1848, when thousands of trees were found so badly infested that they had to be destroyed. Since then the insect has been reported as doing more or less damage in every section of the country. The pest is distributed upon nursery stock, and the importance of carefully examining nursery stock before setting is strongly urged.

Description and Life History.

The eggs, which are very minute, are laid in the crevices of the bark at or near the surface of the ground.

The young when first hatched appear like specks of mold, being covered with fine white down. As they get older, the cottony covering becomes more distinct, apparently issuing from the pores of the skin of the abdomen and attaining considerable length. The young have beaks longer than the body and, when grown, this organ is fully two-thirds the length of the body. By means of the beak, they attach themselves to the roots or branches, and when abundant, draw heavily upon the vitality of the tree, or may even kill it.

When full grown the females are about one-tenth of an inch long, oval; head and feet black; legs and antennæ dusky; abdomen yellowish; body covered with white mealy powder; a tuft of long, easily detached down upon the hinder part. Under each patch of down is usually found a female and her young. During the summer the females are wingless

and the young are produced alive. Toward the fall the broods contain both winged females and winged males, which have not much down on them and are plump and nearly black. The fore wings are about twice as long as the narrow hind ones. These winged females fly about to other trees and lay eggs, establishing new colonies. During the early part of the season this form of the insect is found in clusters about the base of the trunk, upon suckers or twigs springing from the trunk, but in autumn they commonly attack the axils of the leaves and sometimes cover the whole under surface of the limbs and trunk, making the tree look as though whitewashed.

Remedies.

In early spring wash the tree with a strong solution of soft-soap or washing powder. Later in the season spray with kerosene emulsion.

B. INSECTS AFFECTING THE FOLIAGE.

THE BUD MOTH. *Tmetocera ocellana*, Schlieff.

This is probably one of the worst pests to apple orchards in Maine. It works in the unfolding flower and leaf buds of orchard trees, often doing great damage to the crop, besides attacking nursery stock and young trees. It seems to be on the increase in Maine and did much damage in the season of 1899. It is an European insect but is now widely distributed in the northern U. S. and Canada. Besides the apple, it feeds upon the pear, plum, cherry, quince and peach trees, and in Maine has been bred from blackberry plants.

Description.

Eggs.—Disc-shaped, transparent, flattened, usually oval or sometimes circular in outline. The center of the disc elevated, the outer flat rim attached to the leaf.

Larva.—When first hatched, greenish, with head and first thoracic segment black. It molts four times before hibernating. The half-grown caterpillar, which appears on the buds in spring, is about one-sixth of an inch long, brown, with a black head, thorax, shield and legs. When full fed, about the last of June, it changes to the pupa stage within a tube of dead leaves.

Pupa.—Light brown, about a quarter of an inch long. On the back of each abdominal segment are two transverse rows of teeth directed backward.

Perfect Insect.—A moth with three-fifths inch spread of wings. It may be known by the ash-gray color of the fore wings, which are banded across the middle with a cream white band.

Life History.

The half-grown, brown, hibernating caterpillars usually emerge from winter quarters about the time the buds begin to expand, their first appearance depending on the advance of the season, and ranging over two or three weeks. When they are out early, they gnaw into the buds. If the buds are open they crawl inside. They attack both flower and leaf buds, fastening the parts together with silken threads, forming a nest, within which they feed upon the enclosed tender flower or leaf parts. They do not confine their depredations to a single leaf or flower in the bud, but increase the injury done by sampling nearly all. They sometimes bore down the stems a few inches, killing the terminal shoots. The bud attacked turns brown, making the nest conspicuous. The caterpillars feed mostly at night for six or seven weeks and molt three times. When full grown the caterpillar forms a tube out of leaves, which it lines with thin, closely woven silk, and within it soon changes to the pupa. In about ten days the pupa works its way nearly out of the tube by the hooks on its back. The skin splits open and the moth appears. The moths are on the wing during the latter part of June and the first of July. They fly mostly at night, resting on the trees during the day time, when they are easily detected by the white bands on the wings. They live two or three weeks, during which time they mate and the eggs are laid. The eggs, which resemble small fish scales, are laid singly or in clusters, mostly at night, on the under side of the leaves. The eggs hatch in seven to ten days. The young larvæ feed upon the epidermis of the leaf, forming a silken tube for protection. After the fourth molt, which occurs the last of August or the first of September, or before the leaves fall, they leave the silken tubes and form a silken winter home (*hibernaculum*) on the smaller twigs near the buds, in which they spend the winter. The appearance of the hibernating larva in the spring completes the cycle of life.

Remedies.

Pull off and crush the withered clusters of leaves containing the caterpillars and chrysalids early in spring.

Spray with Paris green or with Bordeaux mixture and Paris green, as soon as the buds begin to swell in the spring.

THE OBLIQUE-BANDED LEAF ROLLER. *Cacæcia rosana*, Harris.

This is a native species, reported from several localities in the United States, and one of several species responsible for the destruction of the buds and foliage of apple trees. We have bred it from the leaves of the apple, currant and strawberry in Maine. It also feeds upon the plum, pear, peach, cherry, rose, and a great variety of other trees and shrubs.

Description.

Eggs.—So far as we know, the eggs have not been described.

Larva.—Length .8 of an inch; livid green when young, becoming yellowish green, reddish or brownish with age. Head oval, top of first segment yellow or brown; usually a darker green stripe along the back. The posterior half of the segments wrinkled transversely, and bearing a few minute tubercles from which single hairs arise. When mature the larva spins a silk lining to the leaf in which it lives and changes to a chrysalis of a dark brown color from which emerges the moth.

Perfect Insect.—A short, broad, flat, bell shaped moth, with about one inch spread of wing. The wings pale, reddish brown, crossed with wavy, pale brown lines and with three oblique darker brown bands, one of which covers the base of the wings, another the middle and the third a triangular spot on the front margin near the tip.

Life History.

As soon as the leaves start, the caterpillars begin to coil up and fasten together the young leaves which they feed upon, and in which they find shelter. They attack the buds, leaves and also the young fruit, gnawing its surface or eating deep holes into it. They are full grown the last of June or early in July, when each lines its leaf house with silk, and changes to the chrysalis, from which the moth emerges the last of July. There is a second brood in August. We know nothing of its egg laying habits, or how or where it spends the winter.

Remedies.

The same remedies may be used for this insect as for the bud moth.

THE LESSER APPLE LEAF FOLDER. *Teras minuta*, Robr.

This is another of the small moths that do damage to the buds and leaves of the terminal shoots of the apple tree. It is particularly bad in Maine. It is said to be specially bad in nursery stock, and young orchards, but large trees also suffer. This is a well known cranberry insect and may get into orchards from the bogs.

Description.

Eggs.—The eggs, so far as we know, have not been described.

Larva.—A small, greenish yellow, active caterpillar, with a pale brown head. When disturbed it seeks the more secluded parts of its burrow, or if too much molested, wriggles out and drops to the ground.

Chrysalis.—Within the folded leaf, the larva spins a silken web and changes to a brown chrysalis, three-tenths of an inch long. There is a characteristic knob-like projection from the head end of the chrysalis.

Perfect Insect.—A small moth, with one-half inch spread of wing. There are three broods and the insect is dimorphic, the moths of the third brood being very different in color. These dimorphic forms were thought to be different species until carefully bred and studied. The moths of the first two broods have the head, thorax and fore wings a bright orange color; the hind wings, body and legs are whitish with a silken lustre. The moths of the third brood have the fore wings of a uniform ash-gray, or slate color with reddish luster by oblique light; hind wings light colored and semi-transparent.

Life History.

The gray-colored moths of the third brood hibernate in some sheltered place during the winter. In the early spring they come forth and deposit their eggs on the buds or unfolding leaves. The eggs hatch in a few days and the larvæ crawl between the unfolding leaves and begin feeding upon them, often fastening one or more leaves together by a silken web and living within them. They live upon the epidermis and pulp, but sometimes gnaw holes in the leaves, and sometimes forsake the nest, to feed on adjacent exposed leaves. When mature they spin a silken lining to the leaf and change to the chrysalis, where they remain about a week, and early in May the orange-colored moths of the first brood come forth. The larvæ of the second brood appear the last of May or early in June, and the moths the last of June or in July. The moths of the third brood appear in August, and hibernate, completing the round of life.

Vulnerable Points and Remedies.

The young larvæ of all the broods are exposed when they first hatch and before their leaf shelter is made. The same remedies apply to this insect as to the bud moth.

THE FOREST TENT CATERPILLAR. *Clisiocampa disstria*, Hübner.

There are two tent caterpillars in the eastern United States; the apple tree tent caterpillar, *Clisiocampa Americana*, and the forest tent caterpillar, which was called by Prof. Harris *Clisiocampa sylvatica*, but in recent literature is known as *Clisiocampa disstria*. Both species are common in Maine but are often confounded. Though similar in their life history, they are readily separated by differences in the egg clusters, caterpillars and moths.

Distinguishing Characteristics.—Egg clusters of this species, the same diameter throughout, docked off squarely at the ends; caterpillars with a row of spots along the back; oblique lines on the wings dark colored; web inconspicuous, closely attached to the limbs or trunk and easily overlooked. Insect restless, wandering from tree to tree. Occurs in orchards but, being a general feeder, is more commonly found on forest or shade trees, from which habit it receives its common name.

Description.

Eggs.—The egg clusters, composed of about 300 to 400 eggs, are attached to the terminal twigs of the food plant. They are of the same diameter throughout and cut off squarely at the ends. The eggs are creamy white, rounded at the base, enlarging upwards, narrowing again at the top and terminated by a circular rim on the border and a sunken spot in the center. They are held to the twig and to each other by a brown varnish, which also covers the egg clusters, protecting them from the weather and probably from their enemies.

Larva.—The eggs hatch in the early spring, usually about the time the buds are bursting. The time, however, varies with the exposure of the egg clusters to the sun, and also with the season. In Maine they are hatched the last of April or early in May. Sometimes, during continued warm weather, the eggs hatch before the leaves start, and cold weather comes on afterwards. The young larvæ are very hardy, however, and are not often killed. We have kept them alive in breeding cages for three weeks without food. They will eat the varnish on egg clusters. As soon as hatched they spin a web wherever they go, possibly to enable

them to retrace their steps. Soon the branches are lined with these silken paths along which they travel in search of food. They shed their skin (molt) four times, changing color and markings in the first three. They are full fed in about six weeks, though the growth may be hastened or retarded by the weather or food supply. At this time they may be seen wandering about for a suitable place to spin their cocoons.

Cocoon.—The larva spins a whitish-yellow cocoon, resembling that of the apple tree tent caterpillar, and by preference folds it in a leaf, but often attaches it to loose bark or about fences, houses or other places of concealment. Inside of the cocoon the caterpillar changes, in two or three days, to the chrysalis. In two or three weeks the moths emerge.

Perfect Insect.—A brownish yellow moth, expanding an inch and a half or more. The fore wings marked by two oblique brown lines, the space between them usually darker than the rest of the wing. The moths eat nothing. After they have mated and laid their eggs, they die, completing the life history.

Remedies.

(a) Collect the egg clusters in winter when the trees are bare.

(b) While young the caterpillars can be destroyed by spraying with Paris green, but when half grown the amount of poison they get in feeding will not kill them.

(c) After the third molt, they collect in bunches, on the trunks and branches, and can be reached by hand or by spraying. A solution of one pound of washing powder in four or five gallons of water, applied to the bunches by means of a swab attached to a long pole, has proved effectual.

(d) After the caterpillars begin to collect in bunches, or even before, spread a sheet of canvas under the tree. Climb the tree and with a padded mallet suddenly jar the branches on which they rest, and they will fall on the canvas and can be swept up and destroyed. This method is applicable to both orchard and shade trees, and would recommend itself to town authorities, as by the employment of a few men for a few days in June, in Maine, the shade trees could be protected.

(e) Put bands of cotton, or of tarred paper bearing a ring of a mixture of equal parts of sulphur and lard, around the trees, or use any other practical method to prevent them from ascending the trees. In our own experience a band of paper covered with the lard and sulphur mixture has proved an absolutely effectual barrier.

(f) The moths are night fliers and are attracted by electric lights and many are probably destroyed this way. The cater-

pillars, cocoons and moths should be destroyed by hand whenever possible.

(g) The city of Rochester, N. Y., has successfully enlisted the services of the school children in protecting the city shade trees. Pride in one's city adornment could be thus stimulated in pupils, and by collecting the egg clusters, caterpillars, cocoons and moths, a valuable and practical lesson in nature study would be learned. It would pay town authorities to offer a small bounty, if need be, to stimulate the collecting. All specimens collected should be burned.

Remarks.

For a fuller consideration of this insect and illustrations of all the stages in its life history, the reader is referred to Maine Experiment Station Report, 1888, p. 164; 1889, p. 188; 1890, p. 138, and 1897, p. 173; or to the Maine Agricultural Reports of the corresponding years.

THE APPLE TREE TENT CATERPILLAR. *Clisiocampa Americana*, Harris.

This insect is a native of North America and occurs wherever apples are grown. It has given more or less trouble to apple growers since the early settlement of the country. While it prefers wild cherry, and selects the apple as second choice, it feeds upon plum, peach, rose, and other members of the rose family; also upon the oak, poplar, willow, birch, witch hazel, beech, etc.

Description and Life History.

Eggs.—Dull gray; the upper end circular with a dark spot in the center. They are laid in clusters round the twigs and covered with varnish to protect them from the weather. There are from fifty to two hundred and fifty in a bunch.

Larva.—When first hatched they are dull black and sparsely covered with gray hairs. They appear about the time the leaves start, but if ahead of them, may feed for a time upon the varnish covering the eggs. They molt about six times. The larvæ soon begin to spin a web which increases in size by additional layers of silk as the worms grow, until it is sometimes ten inches or more across. The worms remain in the tent at night, during stormy weather and when not feeding, unless the weather is warm, in which case they may often be seen upon the outside, literally covering the web. They march in military order twice a day from the nest to feed, once in the morning and once in the afternoon.

They pave their roads with silk and follow along them to the leaves. When mature, each worm will consume two leaves a day and an average of five hundred leaves would be required for a colony. There are often several webs in a tree. The effects are to rapidly defoliate the tree and draw heavily upon its vitality to produce new leaves. The caterpillars require about six weeks to mature and are then about an inch and three-fourths long. The worms have a "white line along the back, then a yellow line dotted with black, then a black stripe marked with blue and yellow dots, then a wavy yellow line dotted with black, then a blue stripe dotted with yellow, then a broken white line; head black, under side of body black, the body covered with yellowish or whitish hairs." When mature the larvæ leave the tree and wander about in search of a place to spin their cocoons. They prefer the loose bark of trees, or the under side of fence caps, and will enter sheds and porches and climb the sides of houses and transform under the edge of clapboards, window caps and eaves. When the orchard is near they become a nuisance by entering the house.

Cocoon.—Oblong oval, light yellow, formed of a loosely woven, outer covering and a dense, tough, inner coat. The larva enclosed becomes a brown chrysalis and in about three weeks the moth appears.

Perfect Insect.—A moth of a pale, dull, reddish or reddish-brown color. The fore wings crossed by two oblique, parallel, dirty-white lines. The female is larger than the male. The male has feathery antennæ. The moth has no mouth and takes no food and lives only a few days. Its office is to lay the eggs.

Remedies.

Most of the remedies suggested for the forest tent caterpillar are equally valuable in controlling this insect. As this species does not migrate, the jarring and the protective bands are useless.

THE FALL WEB WORM. *Hyphantria cunea*, Drury.

The fall web worm is a native insect which has from time to time done great damage to forest and fruit trees. It is a general feeder, having been observed to feed upon over one hundred different species of trees, shrubs and herbs. It makes a web which is sometimes very conspicuous, attaining dimensions of several feet. The web can readily be told from that of the apple tree tent caterpillar.

We found this insect abundant in western Maine on July 5 when the webs were already quite conspicuous. In "Forest Insects," issued from the U. S. Department of Agriculture, Dr. Packard, on page 244, says: "The name fall web worm is most

expressive for New England and other northern states where the insect is single brooded, appearing there during August and September, while in more southern regions it is double brooded." Though we have not traced this insect through its life history in Maine, and cannot positively say that there are two broods, yet the fact that the webs were conspicuous and the larvæ fully three-fourths of an inch long early in July, would indicate two broods in western Maine.

Description.

Egg.—About one-sixth inch long, bright golden yellow, globular, ornamented with numerous regular pits, which, according to Packard, give it, under the magnifying lens, the appearance of a beautiful golden thimble.

Larva.—Pale yellow when young, with two rows of black marks along the body, a black head and sparse hairs. Full grown larva usually pale yellowish or greenish with a broad, dark stripe along the back and a yellowish stripe along the side, covered with whitish hairs that spring from black and orange yellow warts. The caterpillars are somewhat variable as to depth of color and marking, even on the same tree. The fall brood is generally darker colored than the spring brood.

Cocoon.—Thin, almost transparent, composed of a slight web of silk intermixed with a few hairs from the caterpillar, or sometimes mixed with sand when the cocoon is spun in the soil.

Pupa.—Length .6 inch, breadth in the middle, .23 inch; dark brown, smooth, polished, faintly punctuate, and bulged a little all around in the middle.

Perfect Insect.—A moth which varies greatly in size and color. These color varieties have received different names by entomologists, but are now reduced to *H. cunea*, Drury. The most common form is white or slightly fulvous with white wings, but the wings show variations from pure white to those profusely dotted with black and brown. Front thighs tawny yellow, sometimes marked with a large black spot; feet blackish; expanse of wings one and one-fourth to one and two-thirds inches. Male moth usually smaller with the antennæ doubly feathered beneath. The antennæ of the female possesses two rows of minute teeth.

Life History.

The female deposits her eggs in clusters, laid in regular rows or smaller irregular patches, on either side of the leaves, usually near the end of a branch. Each female lays on an average about five hundred eggs. Those for the first brood are deposited by the last of May or during June, and the time required for them to hatch depends upon the weather. Under favorable circumstances they mature in about ten days, or those of the second

brood in eight days. As soon as the caterpillars hatch they spin a small silken web which soon becomes conspicuous. Under this they feed together, upon the upper surface of the leaves. As they grow, other leaves and branches are included until the web reaches considerable size and contains dead leaves and the molt skins of the larvæ. If their food supply gives out, they quit the web and drop to the ground and crawl directly toward other trees with almost unerring instinct, or, when disturbed, let themselves down by a thread and by this regain the tree when the danger is past.

When full grown they are nearly two inches long and leave the web and wander about for suitable places to spin their cocoons. They select crevices in bark, the angles of tree boxes, rubbish about the base of trees, and other similar situations, while the fall brood prefer to bury themselves in the earth if possible, but adapt them selves to circumstances. They soon spin their cocoons. The pupæ contained in these hatch into the second brood of moths about the first of August, and the moths lay eggs which hatch into caterpillars that feed, mature, and spin their cocoons during August and September. The insects invariably spend the winter in the chrysalis state in the cocoon, and the following spring the moths emerge and lay their eggs, thus completing the life history.

Remedies.

Spray with Paris green before the insect makes much headway. If there are but few webs on the tree, cut off the branches and burn. Another effective remedy is a strong alkali, whale oil soap, or washing powder solution applied with a swab.

There are several predaceous insects which attack the larvæ, the most important being the spined soldier bug, *Podisus spinosus* (Dallas).

THE LIME TREE WINTER MOTH. *Hybernica tillaria*, Harris.

This is a native species often associated with the fall canker worm, which it resembles very much in its life history. It seems to remain and do damage when the fall canker worm has disappeared.

Description.

Eggs.—Pale yellow, oval and marked with a network of raised lines. They can be distinguished from the eggs of the canker-worm by their color and form. (See Report Maine Experiment Station, 1888, p. 167, Fig. 20).

Larva.—When full grown, about an inch and a quarter long; head dull red with a V-shaped mark on the front; yellow above and marked with many longitudinal black lines; the under side paler. Like the larva of the canker worm, it is a span or inch-worm, but it is larger than the caterpillar of that species.

Female Moth.—Wingless, spider-like, yellowish white; sides marked with black dots. Each ring of the body, excepting the last, which has only one, bears two black dots. Head black in front; antennæ thread-like. Ovipositor jointed and retractile; legs ringed with black. The larger size, the spotted back, and the black rings on the legs readily distinguish this from the wingless females of the fall and spring canker worms.

Male Moth.—Expanse of fore wings an inch and a half; color rusty buff, sprinkled with brownish dots and with two transverse, brown, wavy, lines, the inner most distinct. Between the bands and near the anterior edge is usually a brownish dot; hind wings paler; body color of fore wings; antennæ feathered. Like most of the moths of the inch worms, the wings are very delicate. The moths of the canker worm are on the wing at the same time, but they are smaller and are thus readily distinguished.

Life History.

The eggs, which are laid in situations similar to those of the canker worm, hatch early in the spring and the young larvæ feed upon the foliage of the apple tree, basswood, elm, hickory, etc., and when full grown, about the middle of June, they usually let themselves down by a silken thread, enter the ground about five or six inches and form a little oblong cell, within which they change to the chrysalis state. In October or November (sometimes not until the following spring), the moths appear. The wingless females climb the trees or other objects where they meet the winged males, pair and soon deposit the eggs in clusters, usually upon the branches of the trees they have infested, completing the life history.

Remedies.

The life history of this species is so nearly like that of the canker-worm that the remedies suggested for that insect are applicable to this. It has never done as much damage as the canker worm, but it is capable of doing much injury to the foliage of apple trees.

THE APPLE LEAF BUCCULATRIX. *Bucculatrix Pomifoliella*,
Clemmens.

This moth was described by Clemmens in 1860. It is known to be widely distributed, having been reported from Texas, Missouri, Massachusetts, New York, and now from several localities in Maine. It has done considerable damage to the foliage of apple trees especially in New York.

Description.

Eggs.—So far as we know, the eggs of this species have never been described. They must be quite small as the cocoons of this diminutive moth have been mistaken for insect eggs. They are said to be laid upon the leaves.

Larva.—About one-half inch long when mature, cylindrical, tapering at both ends. Joints of the body rounded and prominent, color dark yellowish, with a greenish tinge and reddish shades on the anterior segments. Body armed with short black hairs which are more numerous on the back of the first segment. Head small, brown and ellipsoidal. The larvæ are active and when disturbed suspend themselves by a silken thread.

Cocoons.—Dirty white, slender, about one-fourth inch long, ribbed longitudinally by about six prominent ridges, oblong, tapering at both ends, flattened on the side to which it is attached. Usually fastened to the twigs and branches in groups.

Chrysalis.—Dark brown, rough, punctured on the back, about one-tenth of an inch long. When ready to transform, the chrysalis works itself partly out of the cocoon and the moth comes forth.

Perfect Insect.—A small moth that has only about one-fourth inch expanse of wings. Fore wings whitish, tinged with pale yellow and dusty brown. On the middle of the inner margin is a conspicuous oval brown spot; a wide streak of the same color on the opposite margin extending nearly to the end of the wing, where it tapers and points to a small circular brown spot near the tip.

Life History.

This insect spends the winter in the pupa state in the cocoon, usually attached to the twigs and branches of the host plant. There is reason to believe that the larvæ, when full grown, sometimes desert the host plant and form their cocoons on other plants close by. We have seen cocoons on the side of a building in Maine. About the time the leaves unfold, the moths come forth and lay their eggs upon the tender foliage. The larvæ are full grown in July. The specimens sent us in July were in the

larval form and went into the chrysalis state in August and emerged the following spring, a fact which would indicate only one brood in Maine. Prof. Riley believed that there are two or three broods in the latitude of St. Louis, Mo. In the latitude of New York, Prof. Lintner states that there are two broods, one in July and one in September.

In September or October the cocoons in which the pupæ spend the winter are formed. The larvæ feed externally upon the foliage, at least the leaves we have received had the upper epidermis and pulp eaten away in patches, the veins and lower epidermis intact.

Remedies.

(a) Jar the trees when the larvæ are full grown and they will suspend themselves by threads and can be swept down by a broom and killed by hot water or crushed.

(b) Apply kerosene emulsion with a spraying pump in winter, to the branches that bear the cocoons. The same application might be made for the first brood when the foliage is on.

(c) If in small numbers, the cocoons may be removed during the winter months by hand.

(d) Spray with Paris green, as for other leaf eating insects. This small moth is preyed upon by several parasites that attack the larvæ and hold the pest in check, and some of the cocoons probably suffer somewhat from inclemency of the weather. Possibly birds may eat them, but we find no record of observations.

THE WHITE-MARKED TUSSOCK MOTH. *Orgyia (Notolophus) leucostigma*, Sm. & Abb.

During the past ten years specimens of the above insect, in the egg, larval and wingless female stages of its life history, have been received at the Experiment Station from various parts of the State. It is a native species and is apparently widely distributed, having attracted considerable attention as an apple insect.

Description.

Eggs.—Three or four hundred in a mass, attached to the empty grayish cocoon previously occupied by the female moth. Egg mass convex, smooth, grayish-white; composed of several layers of eggs, with a frothy, gelatinous material between them.

Larva.—When mature, over one inch long; bright yellow; head, and two small protuberances on the back carrot-red; back ornamented with four cream-colored brush-like tufts; two long black plumes near the head and one near the posterior end of the body; sides clothed with yellow hairs; brown or black stripe on the back, and a dusky stripe on each side.

Cocoon.—Gray; spun on the inside of a leaf. Texture loose and the silk interwoven with numerous hairs from the caterpillar. Chrysalis, enclosed in the cocoon, oval, brown or sometimes whitish below, covered with whitish hairs or down.

Perfect Insect (female).—Wingless or wings mere rudiments; light gray, oblong-oval; body distended with eggs; legs long.

Perfect Insect (male).—Winged, expands an inch and a quarter; fore wings crossed by wavy bands of darker shade; a small black spot on the outer edge of the wing toward the tip; beyond it an oblique blackish stripe, near the outer hind angle a minute white crescent; body gray, with a small black tuft near the band of the abdomen; antennæ feathered.

Life History.

During the winter months there will occasionally be found in the orchard, dead leaves attached to the branches of the trees. Upon examination these will usually be found to contain an empty, gray cocoon with a mass of eggs attached to it, as described above. These eggs hatch, in Maine, about the first of June, or earlier farther south. The young larvæ at once begin to devour the leaves of the tree. When disturbed they lower themselves by means of a silken thread which they climb when danger is past. The beautiful caterpillars described above feed about two months and then spin their cocoons. The moths soon emerge and the wingless females, being little more than animated masses of eggs are sluggish. The males, having wings, are able to fly, and they meet the females while resting upon the empty cocoon to which the mass of eggs is finally attached. If there is only one brood, the eggs do not hatch until the following spring; if two broods, the eggs soon hatch, producing the second brood of caterpillars which complete their growth late in the season and enter the chrysalis state. The moths soon emerge, mate, and the female lays the eggs on the cocoon, completing the life history.

Remedies.

Collect and destroy the eggs and cocoons during the winter. Spray with Paris green, or with Paris green and Bordeaux

mixture. Usually no special treatment is required for this insect if the trees are thoroughly protected from the tent caterpillar.

THE FALL CANKER WORM. *Anisopteryx pometaria*, Harris.

This insect has been very bad at times in Maine, doing much damage to fruit and shade trees. Parasites and other enemies soon control it, however, so that it does not usually do damage in the same locality more than two successive seasons.

Description.

Eggs.—Grayish, flattened above, with a central puncture and a brown circle near the border. Each female lays 100 or 200 eggs in rows arranged in clusters on the twigs or branches, or on fences and buildings, usually in exposed situations.

Larva.—Pale olive green when young, but varying in color, when grown, from greenish yellow to dark brown. Dorsal band broad, brownish; lateral lines three, white, the middle one paler; broad brown bands below the lateral lines, and below that a broad white band. Under side, flesh-colored; head brown.

These caterpillars belong to the group of inch or measuring worms, because they alternately loop and extend the body in moving. When at rest they sometimes assume an erect position, and can hardly be told from twigs. When full grown they are about one inch long. When mature they crawl down the trunk or let themselves to the ground by a silken thread, and burrow to a depth of from two to six inches. They make a tough cocoon of buff colored silk interwoven with earth, and in twenty-four hours turn into the chrysalis.

Chrysalis.—Light greyish brown; about half an inch long. The male slender, and provided with wing cases; the female larger, and without wing cases.

Perfect Insect (male).—A moth provided with wings, the fore wings brownish gray, glossy, crossed by two whitish irregular bands, the outer one enlarging into a pale spot at the apex. Hind wings grayish brown with a white band crossing them, and in the center a faint blackish dot.

Perfect Insect (female).—Wingless; uniform shining ash color above, gray beneath; length three to four-tenths of an inch. Sluggish of movement and spider-like in appearance.

Life History.

The eggs hatch about the time the buds on the apple trees expand. The young worms feed upon the tender leaves, seeking shelter within the expanding flowers or buds when the weather is wet and cold. They eat holes in the leaves while young, but

when older devour the whole pulp of the leaf, leaving only the veins and midrib. They feed for about four weeks, and when numerous so injure the foliage as to give the trees the appearance of having been scorched with fire. They have done great damage to the foliage of trees along highways. While letting themselves down to the ground they are often swept off by carriages and carried long distances.

The larvæ enter the ground, spin cocoons and are changed immediately into the chrysalis state, from which, during the fall, winter and following spring, they emerge in the perfect form, completing the life history.

Remedies.

Since the females are wingless, they may be trapped and destroyed by placing bands of tarred paper about the trunks of the trees and smearing these with printer's ink, tar mixed with oil, or refuse molasses. As these materials soon dry, however, they must be frequently renewed, or the insects will be able to cross. Tin or lead troughs, containing crude petroleum, are also used with some success. The most effective treatment, however, is to spray with Paris green, just as soon as the insects appear. Delay in applying the poison is often fatal to success.

There are numerous natural enemies, including a small mite, which destroys the eggs; a species of *Microgaster*,—a small four-winged fly,—parasitic upon the larvæ; and a species of tachina fly, also parasitic upon the larvæ.

THE APPLE TREE APHIS. *Aphis mali*, Fabr.

This insect was originally from Europe, but is now a pest in apple orchards throughout the northern United States and Canada, often causing serious losses in young orchards and nurseries.

Description.

Eggs.—Minute, oval, light yellow or greenish when first laid, gradually changing to shining black.

Young Insects (male).—Head, thorax and antennæ black; neck usually green; abdomen short, thick, oval, bright green; sides with row of black spots; nectaries and tail-like appendages black; wings transparent with dark brown veins.

Perfect Insect (female).—Length of wingless form less than one-tenth inch; body oval, pale yellowish green, often striped with deeper green; eyes and tail appendages black; honey tubes green. The winged female resembles the male in color.

Life History.

The eggs are deposited in the autumn in the cracks of the bark of twigs and at the bases of the buds. The eggs hatch when the buds begin to expand and the lice locate themselves on the young buds and leaves by means of their beaks and feed upon the juices. The spring brood is composed of females and is about ten days reaching maturity. Each louse gives birth to living young, producing about two a day for two or three weeks, and then dies. These young become mothers in about ten days. This process is continued through the season, there being many generations, mostly wingless females, without the appearance of males. Winged females are sometimes produced which, migrating to other trees, spread the pest. Late in the season males and females are produced in the same brood and, after mating, eggs are laid to perpetuate the species, thus completing the life history.

Remedies.

Wash the trees during winter or early spring with a strong solution of soft soap, or of washing powder, to destroy the eggs. Later in the season, if the aphids become numerous, spray with kerosene emulsion or with a strong decoction of tobacco, made by pouring 1 gallon of boiling water over a pound of tobacco stems or leaves.

There are many natural enemies of the aphids which should be encouraged. Among these are seven or eight species of ladybirds, and the larvæ of syrphus flies and of chrysopa or lace winged flies.

THE RED-HUMPED APPLE TREE CATERPILLAR. *Ædemasia concinna*, S. & A.

This species is native to the United States and has been reported from several localities in Maine as doing considerable damage to the foliage of apple trees. It is said to be widely distributed in this country, but is not an abundant species. It

prefers the apple, but is known to feed upon the plum, cherry, rose, thorn, and pear,—plants belonging to the rose family.

Description.

Eggs.—The eggs, so far as we know, have not been described.

Larva.—When full grown, the larvæ are often an inch and a quarter long. They may be known by the coral-red head and a hump of the same color on the fourth ring or segment from the head. The body is striped lengthwise with narrow yellow, white and black lines. There are two rows of black spines along the back, and rows of shorter black spines on the sides. Each spine bears a fine hair. The spines on the coral red hump are more prominent than the others. The hinder end of the caterpillar tapers and is usually elevated when the insect is at rest. When handled, a fluid with a strong acid smell is emitted. This is so offensive that the insects are never eaten by birds.

Perfect Insect.—A moth which measures from an inch to an inch and a quarter across the wings. The fore wings are dark brown on the inner, and grayish on the outer margin. There are several longitudinal streaks along the margin, also a dot near the middle and a spot near the angle, all dark brown. The body is light brown, and the thorax of a darker shade.

Life History.

The moths are on the wing late in June or in July. The female deposits her eggs on the under side of a leaf, in a cluster, usually during July. They soon hatch into small caterpillars. These caterpillars, while young, feed upon the tender tissues of the under side of the leaf, leaving the upper surface unbroken, but when large they devour greedily the whole leaf, excepting the midrib. They reach maturity during August and September. There is but one brood in the northern states. In the broods further south, the caterpillars feed in bunches and when not feeding remain close together. When mature they descend to the ground and hide under leaves or rubbish, or sometimes burrow a little into the ground and slowly change to the chrysalis state, where they remain until the following spring, when the moths appear, completing the life history.

Remedies.

As these caterpillars go in flocks, and when not feeding remain close together, they may easily be destroyed by cutting off the branch on which they appear and burning it. They may also be destroyed by jarring the limb, and, when they fall to the ground,

trampling them under foot. Spraying with Paris green is also effective, but poison should be used with caution on bearing trees. It is said that ichmeumons are parasitic upon them and hold them in check.

THE CECROPIA EMPEROR MOTH. *Platysamia cecropia*, Linn.

This is a native species and the largest moth found in the United States. It is widely spread and a general feeder. It is a well known apple insect, and, though not abundant, attracts attention on account of its large size and voracious appetite. It has been reported in its various stages from every part of Maine.

Description.

Eggs.—Nearly one-tenth of an inch long, almost round, dull creamy white, with a reddish streak near the middle.

Larva.—When first hatched, black with shining black knobs on the body from which arise black hairs. It molts several times in coming to maturity. When full grown it is from three to four inches long and pale green. There are coral red warts on the third and fourth segments, yellow warts on the back of the other segments, except those on the second and terminal, which are blue like the smaller tubercles on the side.

Cocoons.—About three inches long, pod-shaped, rusty grey or brown and firmly attached to one side of a twig. Composed of two layers of silk, an outer loose, papery, fibrous one and a densely woven inner one which contains the brown chrysalis.

Perfect Insect.—A moth with from five to seven inches spread of wing. Both the front and hind legs are rich brown. About the middle of each wing is a kidney-shaped white spot shaded with red and margined with black. Near the tips of the fore wings is an eye-like spot containing a bluish white crescent.

Life History.

The moth lays from two to three hundred eggs, usually in pairs, firmly fastened to the under side of the leaves of the host plant. The eggs hatch in a week to ten days, the young larvæ first feeding on the empty egg-shells. They have a ravenous appetite, grow rapidly, and consume a large amount of food. When nearly mature, a few on a young apple tree may in short time strip it of leaves. The larvæ, when full grown in the fall, spin their cocoons, attaching them to the twigs of shrubs or trees on which they feed. Their great size makes them conspicuous objects after the leaves fall. The following spring, in May or

June, the moths appear and soon mate, completing the life history.

Remedies.

The larvæ and cocoons are not abundant, and are so conspicuous that hand picking is the most satisfactory treatment.

C. INSECTS AFFECTING THE FRUIT.

THE CODLING MOTH. *Carpocapsa pomonella*, Linn.

The codling moth is probably native to southeastern Europe, the native home of the apple. It was introduced into the United States probably in apples or pears, early in the history of the country, but it was not noticed until 1849, its work previously having been referred to the plum curculio.

It is found in most of the apple growing countries of the world and is widely distributed in Maine, being one of the worst apple insects. The larvæ, particularly of the second brood, are often in apples when marketed, and crawl out and go into the pupa stage when the apples are stored or exposed for sale. It is not uncommon to see the moths in the spring in apple out-house cellars, or on the windows of stores and houses.

While the codling moth is more particularly an apple insect, it feeds also upon pears, wild haws, crab apples and quinces, of the pome fruits, and upon plums, apricots and cherries of the stone fruits. Specimens have been reared from the fruit of a species of screw bean and from the seed buds of roses.

Description.

Egg.—A thin scale, slightly smaller than the head of a pin; whitish, often with a yellowish tinge, semi-transparent, looking like a minute drop of milk on the skin of the fruit.

Larva.—Whitish, flesh-colored or pink; one-sixteenth of an inch long when hatched; three-fourths of an inch long when full grown; three pairs of true legs and five pairs of false legs; head, first thoracic and anal segments brown; body armed with a few short hairs arising from more or less distinct black spots.

Cocoon and pupa.—When mature the larva spins, in a day, a thin tough silken cocoon, the inner layer thin and white, the outer layer mixed with pieces of the bark or substance on which the cocoon rests. Within the cocoon, or later, the larva changes to the brown pupa.

Moth.—Spread of wing about three-fourths of an inch. Front wing crossed by numerous gray and brown lines, which are often wavy, the hind angle marked by a large, dark brown spot streaked with bronze or gold. The hind wing light greyish-brown with a darker margin. The males have a pencil of long black hairs in a furrow on the upper surface of the hind wing, and on the under side of the front wing an elongate, narrow, black spot.

Life History.

The eggs are laid on the surface of the fruit, on its stem, or on the adjacent leaves. Between the middle of May and the middle of June, a week or two after the blossoms have fallen and the fruit is from a half-inch to an inch in diameter, the young larvæ crawl about on the surface of the fruit. The most of them find their way into the blossom end, where they remain feeding for several days, and finally bore to the core of the fruit. They are full grown in about three weeks, when they make their exit channel to the surface. After feeding a few days near the surface, they emerge and usually spin cocoons under the loose bark of the trunk of the tree. Those designed for the first brood change soon to the pupa and the moths emerge in about two weeks, to lay eggs for the second brood. Those that go into the cocoon in August, and later, remain in the larval state in the cocoon during the winter and emerge as moths the following spring. In Maine only part of the first brood transform to moths the same season. When the moths appear, whether the same season or the following spring, the life history is complete.

Remedies.

As soon as the blossoms fall, spray the trees with Paris green, or with Paris green and Bordeaux mixture. The fallen fruit should be gathered and destroyed. Hogs or sheep may be kept in the orchard for the purpose. Owing to the protection afforded by the apple, the larvæ are particularly free from natural enemies. There are, however, two species of ichneumon flies which are occasionally found as parasites.

THE PLUM CURCULIO. *Conotrachelus nenuphar*, Herbst.

The plum curculio is a native of this country and originally fed upon the wild plums, which it still infests. Both males and females puncture the fruit to feed on it, but only the latter make

the crescent-shaped cuts. This insect is known to infest the plum, peach, nectarine, apricot, cherry, apple and pear. From ten to twenty-five per cent of the early apples examined in July, showed the characteristic cut.

After the first of August but few cuts, made by this insect, were found and we are led to believe that they prefer the earlier varieties, and that the apples punctured do not mature. A large per cent of the larvæ which hatched did not reach maturity. We, however, succeeded in transforming enough to identify the species. It would seem that the plum curculio does not flourish well in the apple and attacks it in the absence of its favorite fruit. The decline in the cultivation of plums, due to the ravages of this pest, and the black knot, will account for its attacking apples.

Description.

Egg.—Oblong, oval, pearly white. Visible to the naked eye, and can be found readily by examining the crescent-shaped cut made by the female.

Larva.—When young, tiny, soft, footless; head distinct, horny. When full grown it is usually of a glossy yellowish white, but varies in color with the food; head light brown or yellowish. Along each side is a light line, below which is a row of black bristles and above it a less distinct one, and toward the hind extremity a few pale hairs; length about two-fifths of an inch. The larva is so transparent, the internal organs are plainly seen through the skin, imparting a reddish color to the central parts of the body.

Perfect Insect.—A beetle, belonging to the family of insects known as weevils or snout beetles. It is blackish or greyish, rough, with a black shining hump on each wing case near the middle, behind which is a dull ochre-yellow band marked with whitish about the middle; each thigh has two small teeth on the under side; snout short. Length of insect about one-fifth of an inch.

Life History.

The beetles hibernate in secluded spots during the winter and appear on the wing about the time the plum trees blossom. As soon as the young fruit forms, the eggs are deposited. The female, when about to lay an egg, makes a minute incision with her jaws and then, inserting the snout, enlarges the hole sufficiently to hold the egg, turns around, deposits the egg, thrusts it to the bottom of the hole with the snout, then cuts a crescent-shaped incision around one side of the opening.

Only one egg is laid in a place, though on the apple, several punctures may occur on the same fruit. Each beetle lays from fifty to one hundred eggs and deposits from five to ten a day. The time of depositing eggs by early and late beetles probably occupies about two months. The first apples examined, July first, were badly punctured and no new cuts were found after the twentieth of the month. The eggs hatch in a few days and the larva is full grown in from three to five weeks. The infested apples or plums usually drop to the ground before the larva is grown and when mature it leaves the fruit, enters the ground four to six inches, forms an oval cavity, changes to the chrysalis, and in from three to six weeks the perfect insect is formed and makes its way to the surface, completing the life history. There seems to be some reason for believing that a few remain in the ground all winter. The specimens we transformed appeared in September, about four weeks from the time the larva was mature. We are inclined to believe that those apples in which the egg hatches and the larva grows, drop early. Abortive cuts shrivel and deface the fruit and check its growth, but it may mature.

Remedies.

Spraying with Paris green early in the season and after the blossoms fall is sometimes practiced. On a few trees in the garden, the jarring method employed for plum trees may sometimes be used to advantage. There are many insects which devour the curculio larva as it escapes from the fruit. Foremost among these are two or three species of common ground beetles. The larva of the soldier beetle is also a useful destroying agent, often entering the fruit while still on the tree, in search of its prey.

THE APPLE MAGGOT. *Trypeta (Rhagoletis) pomonella*, Walsh.

This is a native species which originally fed upon thorn plums, and probably wild crab apples, and has transferred its depredations to cultivated apples. It first attracted attention nearly fifty years ago, and as early as 1867 was doing great damage in New York, Massachusetts, Connecticut and Vermont. Since that time it has spread and increased until it is now widely distributed and regarded as one of the worst pests of the apple.

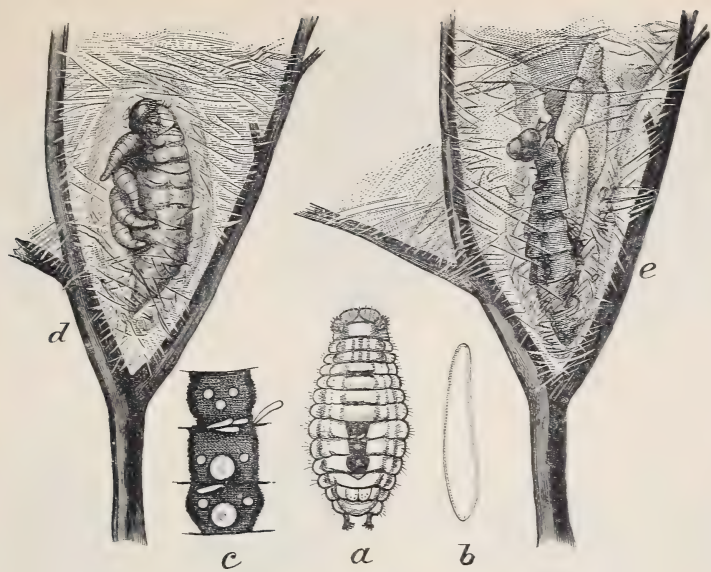


FIG. 1.

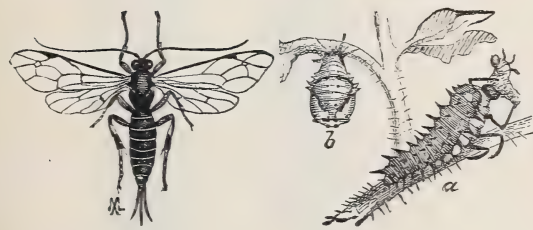


FIG. 2.



FIG. 5.

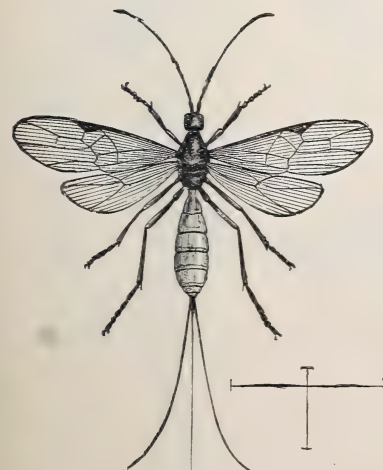


FIG. 4.



FIG. 3.



FIG. 6.



FIG. 7.

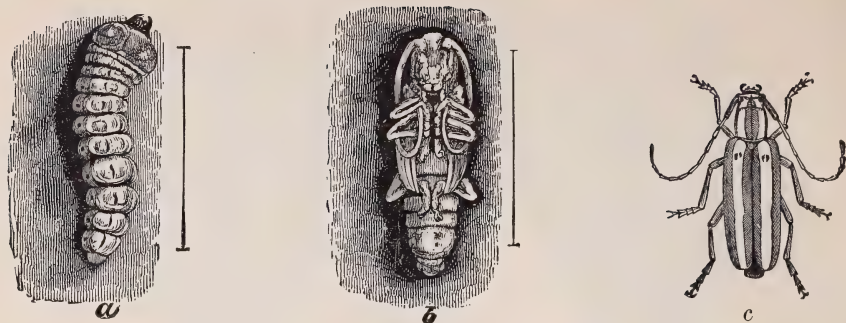


FIG. 1.

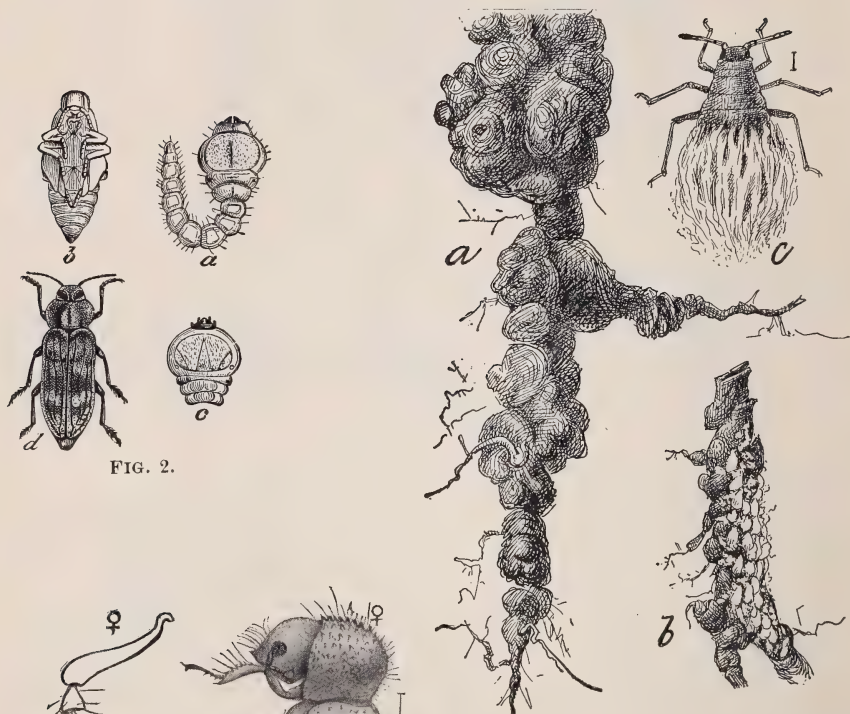


FIG. 2.

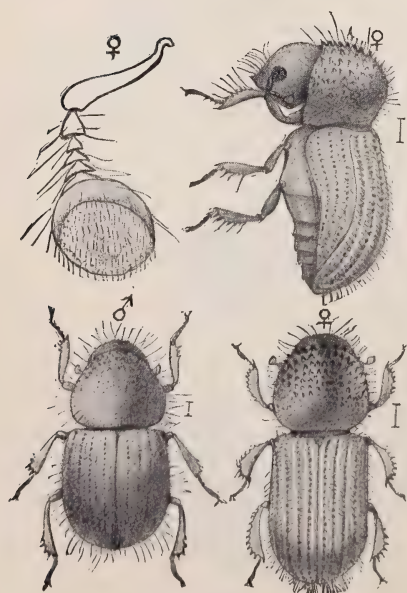


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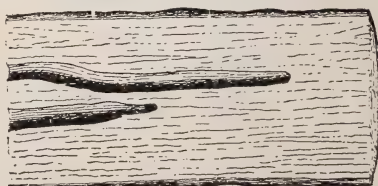


FIG. 5.

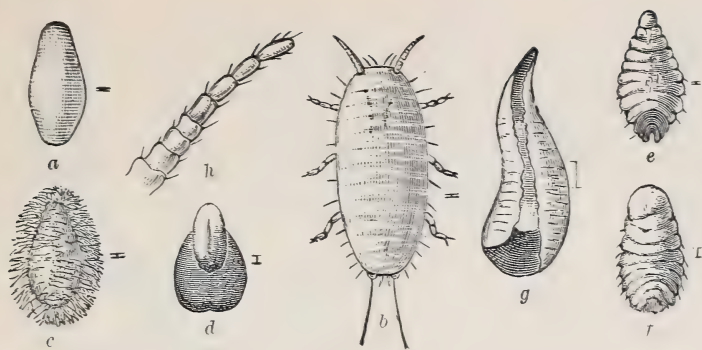


FIG. 1.



FIG. 2.

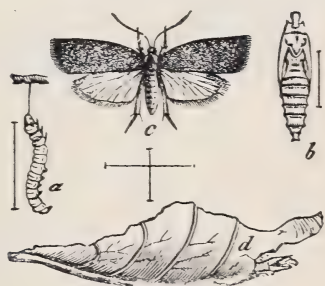


FIG. 3.



FIG. 4.

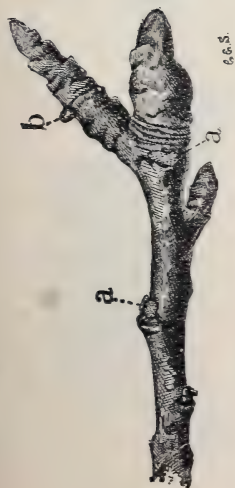


FIG. 6.



FIG. 5.



FIG. 1.

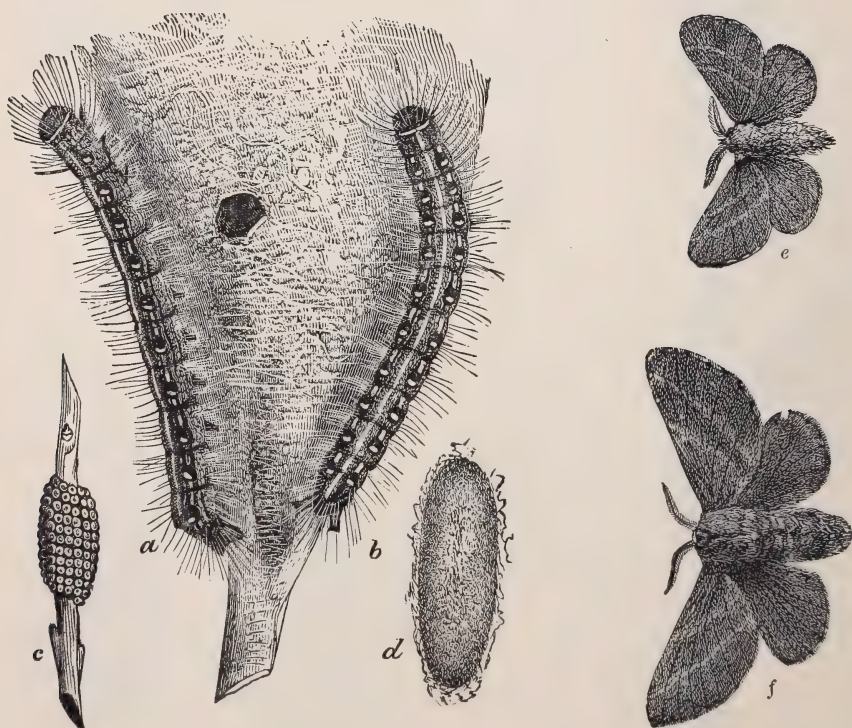


FIG. 2.

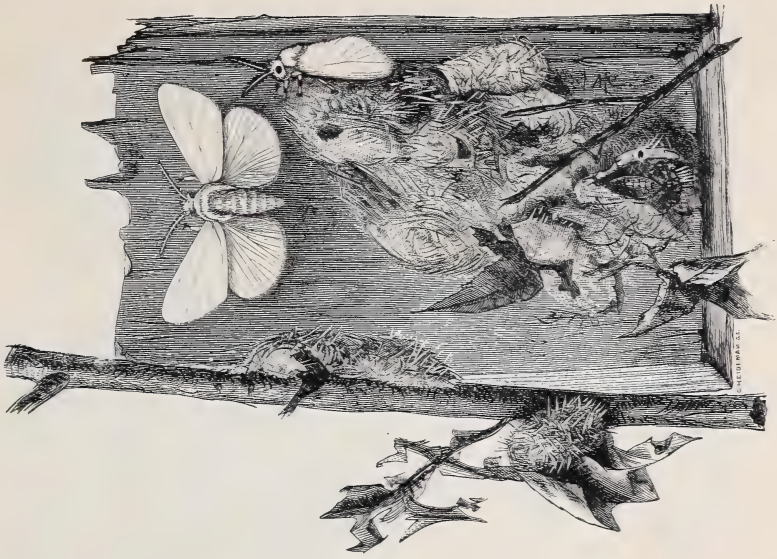


FIG. 1.

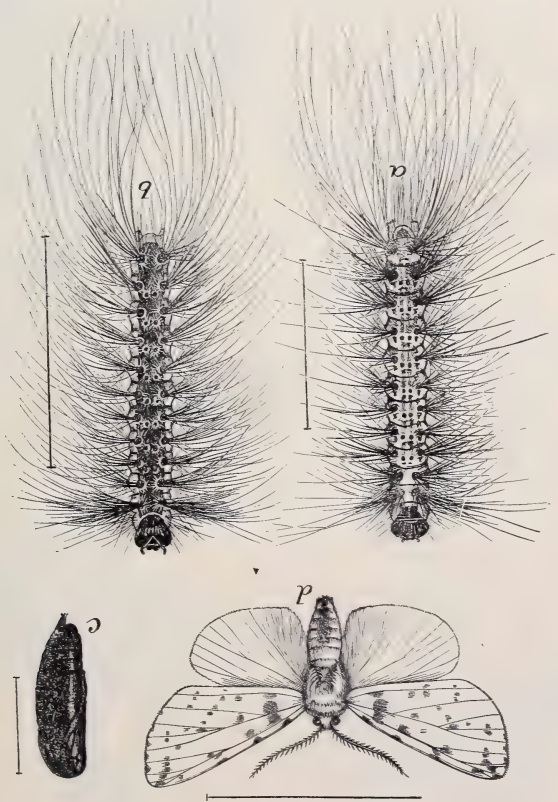


FIG. 2.



FIG. 1.

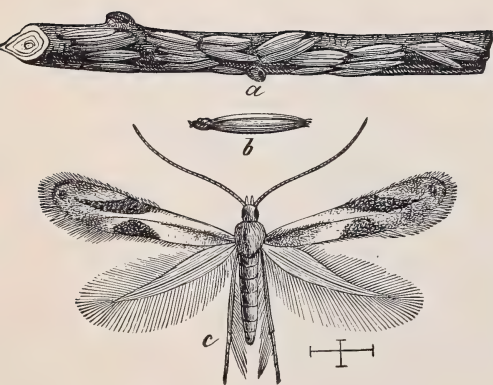


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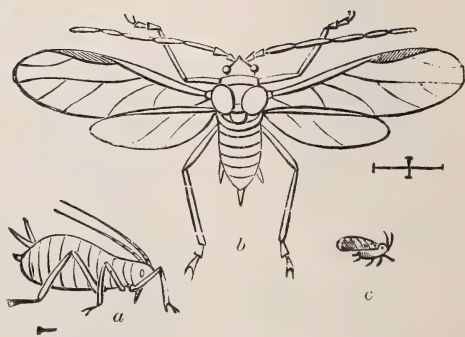


FIG. 3.



FIG. 4.

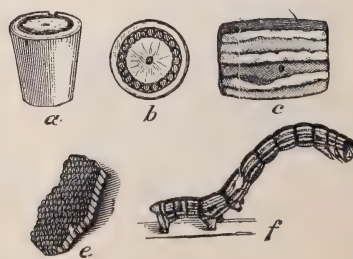


FIG. 5.

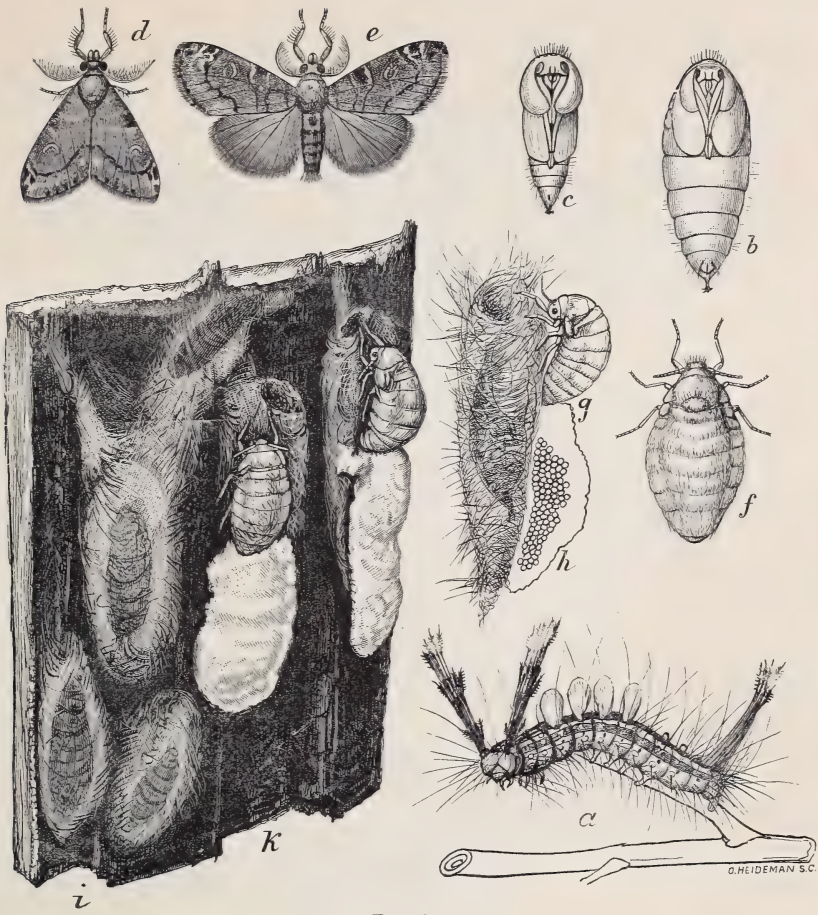


FIG. 1.

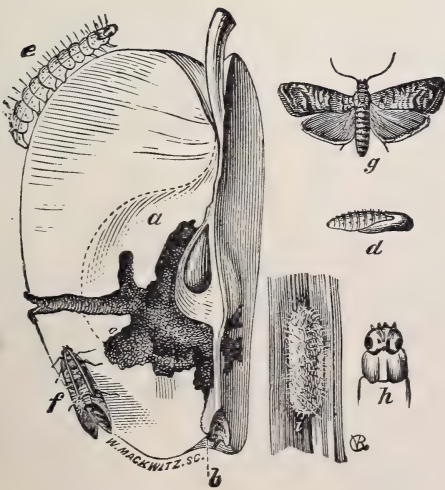


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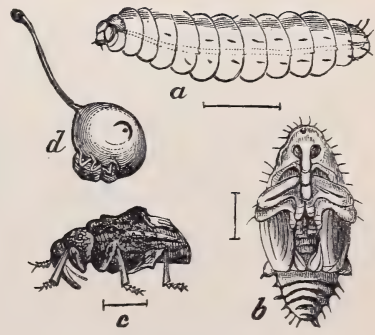


FIG. 3.

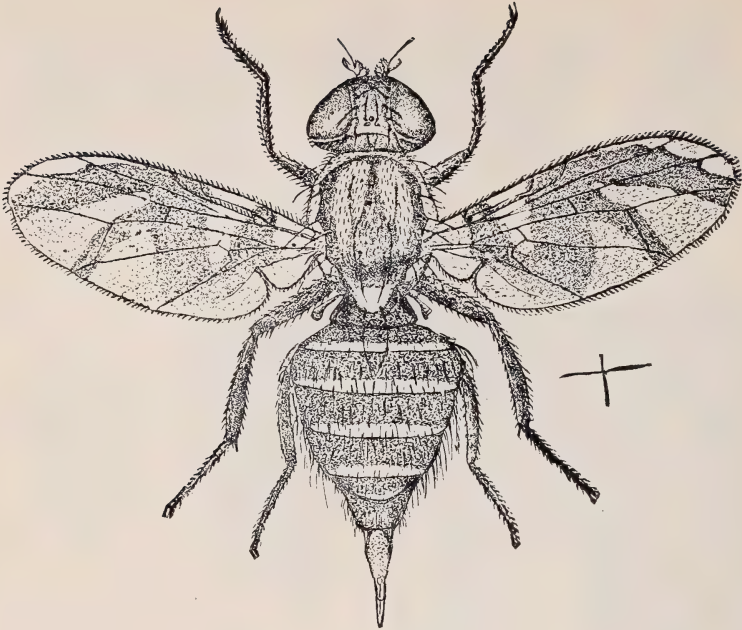


FIG. 1.

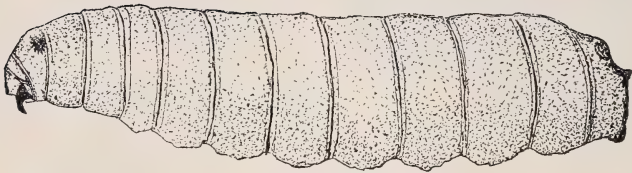


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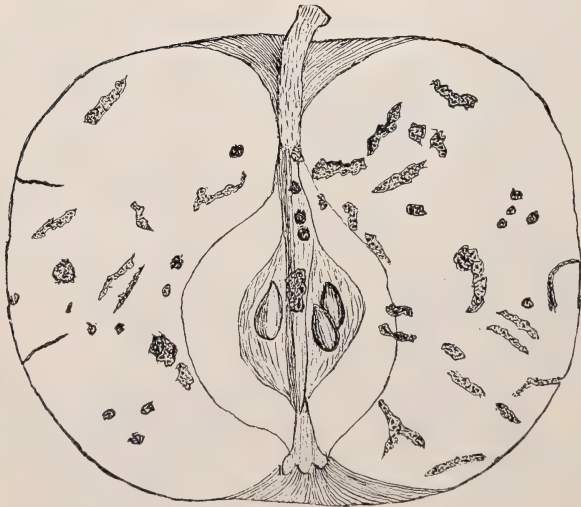


FIG. 3.

It is particularly bad in Maine, attacking nearly all varieties of apples, both fall and winter, though most destructive to the early sweet varieties. It is known as the railroad worm in Maine.

Description.

Eggs.—Length .032 to .036 inch; breadth .008 to .009 inch; light yellow when taken from the fruit; fusiform and about four times as long as wide; pedicellate at the end. The larva is placed in the egg with the head away from the pedicel and the end containing the head is inserted into the apple.

Larva.—Length .28 to .32 inch; breadth .07 to .08 inch. When full grown usually yellowish white. When younger, and sometimes when full grown, tinged with greenish; footless; the body composed of fourteen segments. Ninth, tenth and eleventh segments widest, narrowing rapidly toward the head, which is small, pointed and emarginate. From the broadest segment the body slopes slowly backward to the last segment, which maintains its size one-third of its length and then abruptly slopes to one-half its thickness. The lower and posterior half is nearly vertical behind, giving the larva a docked appearance.

Pupa.—Length .17 to .21 inch; breadth .08 to .1 inch; pale yellowish brown. When the maggot assumes the pupa state it does not shed the larval skin, but contracts, assuming an oval form. The pupa is a little more than twice as long as wide, and barrel-shaped. The ends slope about equally, and the head end is very pointed. Otherwise the resemblance between the pupa and larva is apparent. There is quite a variation in the size of pupæ. Some are much longer and thicker than others and may be of females, as the female flies are much larger than the males.

Perfect Insect.—A two-winged fly somewhat smaller than the house fly. Readily recognized by its general black color; yellowish head and legs; dark feet; greenish prominent eyes; white spot on the back and upper part of the thorax; three white bands across the abdomen of the male, four on the female, and four black bands across the wings, resembling the outlines of a turkey.

Life History.

In early seasons, under favorable conditions, the flies in Maine begin to emerge about July first, and earlier in the states farther south. They continue to emerge all summer and are on the wing in abundance until the middle or last of September, and occasionally in October. Early frosts check them. The flies lived three weeks in confinement and will probably live longer in nature. They begin to deposit their eggs in the early fruit by July first, or earlier, and egg laying continues while the flies are on the wing. The earlier races of flies affect the earlier

varieties, and the later races, the fall and winter fruit. Each female is capable of laying between three and four hundred eggs, and possibly more, which are inserted from time to time, one in a place, by means of a sharp ovipositor through the skin of the apple. The eggs being successively developed in the ovary of the female, after the manner of the eggs of the barnyard fowl, the season of egg laying extends over considerable time. The eggs are vertically inserted into the pulp of the apple, with the end opposite the pedicel, which contains the head of the maggot, pointing toward the core. The eggs are deposited in all parts of the apple, usually upon the cheeks, sparingly near the calyx and stem ends, and more abundantly upon the pale or shaded side of the fruit. The time required to deposit the eggs is about one-half minute. By means of the sharp ovipositor a characteristic puncture is made through the skin of the apple. These punctures can be detected by careful observation with the naked eye, but a pocket lens is necessary to see them well. They appear as brownish specks, and have not been before distinguished from the brownish, rusty spots common on apples. Under the glass they appear as circular or oblong openings, surrounded by a brownish border, somewhat shrunken by the shriveling of the tissue beneath. They may be numerous on the same apple.

The eggs hatch in four or five days, under favorable conditions, and the minute larvæ begin at once to work in the pulp of the apple. They have no true opposable jaws, but the head is provided with two black curved hooks, situated above the mouth, with which they rasp the pulp of the fruit rapidly by means of a vertical movement of the head. They live upon the juice of the particles of apple thus detached, which is sucked into the mouth. The pulp is rejected and turns brown. They can burrow their length in soft fruit in less than a minute. The channels made by the young larvæ, while the fruit is still growing, are largely healed and neither they nor the minute white larvæ are likely to be detected by the naked eye, or by the casual observer. As the larvæ grow, and the fruit matures, the enlarged channels do not heal, but turn brown and the presence of the maggots is then readily detected. These channels meander through the whole fruit, even the core. They often cross each other, enlarge as the larvæ grow, and in the last

stages of *Trypeta* work, run together, producing large cavities. Finally they involve the whole fruit, rendering it a worthless mass of disgusting corruption, held together by the skin.

In the early stages of *Trypeta* work there is no external evidence that the fruit is infested, excepting the punctures made for the insertion of the eggs. In advanced *Trypeta* work, brownish trails, where the larvæ have come to the surface, can be seen through the skin. Apples marketed with no suspicion of their being infested are frequently found hopelessly involved, honeycombed and worthless. Apples apparently sound when gathered may, by the presence of eggs or young larvæ, afterwards become worthless. The newly hatched larvæ are a little shorter than the egg and can not readily be detected in the white pulp of the apple without a pocket lens. They attain their growth, under favorable circumstances, in four or five weeks, but their development may be arrested by cold, by insufficient food, hardness of the fruit, etc., for a great length of time. They ordinarily remain in the fruit but a short time after they mature, and often leave it and go into the pupa state while there is still an abundance of nourishment and the fruit is still occupied by younger larvæ of various ages. If the fruit is kept cold, the larvæ, though full grown, remain longer, or may even change to the pupa state, within it. We have never seen the exit holes in hanging fruit and believe the maggots do not drop, but go into the ground from the fallen fruit. Their presence causes the fruit to mature earlier. Fruit picked from the trees may contain larvæ, and often stored or marketed fruit is alive with maggots.

The exit openings are characteristic, irregular holes, about one-twelfth inch in diameter, surrounded by a brownish border. They look as though the maggots had gnawed a hole for the head, and then forced the body through, leaving a lacerated border. They may occur anywhere on the apple but are more frequently found where the brown larval trails show through the skin. They begin to appear in the early apples about the first of August and may be found until frost, in windfalls, and in the stored fruit as long as the larvæ remain.

It would seem that the development of the larvæ is so nicely timed that they are not mature until the fruit is ripe. Their

development is slower in late and in hard fruits. A dozen maggots may infest the same apple, though a single one is enough to render it worthless. The maggots have been found in numerous varieties, early and late; sweet, acid, and sub-acid, extending from early in July through August, September, October, November, December, January and February. The larvæ usually leave the apples and go into the ground an inch or less and soon change to the pupa state. The pupæ are occasionally found within the fruit in windfalls and quite frequently in stored fruit. Sometimes the larvæ change on the surface of the ground, under decaying fruit. On grass ground they probably change in the debris about grass roots.

Remedies.

The Trypeta is an unusually hard insect to destroy, since the eggs are laid under the skin of apples; the larvæ spend their time within the fruit; the pupæ are safely concealed in the ground, within the shrunken skins of the larvæ; thus in all forms it is immune from the attacks of parasites. The flies do not seem to be attracted by sweetened poisonous substances and cannot be trapped. The eggs are so safely lodged underneath the skin of the apple as to be beyond the reach of poison applied by spraying, hence there is no hope in that direction. The only chance left is to destroy the larvæ and pupæ. This can best be done by destroying the fruit within which they are contained. The larvæ are found abundantly in windfalls and in decayed fruit from the cellars, and the pupæ in bins and barrels where fruit has been stored. Destroying the windfalls, and all refuse fruit, and burning the rubbish from places where fruit is stored are, then, the only reasonable and practicable methods of treatment now recognized.

DESCRIPTION OF PLATES.

PLATE I. Beneficial Insects. See p. 107.

Fig. 1.—*Pimpla inquisitor*, an ichneumon parasite of the tussock moth caterpillar. *a*, parasitized caterpillar; *b*, egg of parasite; *c*, same in situ; *d*, parasite larvæ issuing; *e*, parasite cocoons—all slightly enlarged, except *b* and *c*, which are much enlarged. (After Howard. Farmer's Bulletin 99, U. S. Dept. Agr.)

Figs. 2 and 3.—Ichneumons, parasitic upon apple tree tent caterpillar.

Fig. 4.—Ichneumon parasitic upon flat-headed apple tree borer.

Fig. 5.—The 15-spotted lady bird, destructive to plant lice. *a*, larva; *b*, chrysalis; *d*, *e*, *f*, *g*, various forms of the perfect insect.

Fig. 6.—The twice-stabbed lady bird, destructive to the oyster-shell bark louse.

Fig. 7.—Tachina fly, parasitic on apple tree tent caterpillar.

PLATE II.

Fig. 1.—Round-headed borer (*Saperda candida*). See page 108. *a*, larva; *b*, pupa; *c*, beetle.

Fig. 2.—Flat-headed borer (*Chrysobothris femorata*). See page 109. *a*, larva; *b*, pupa; *c*, head of larva, under side; *d*, beetle.

Fig. 3.—Woolly louse. (*Schizoneura lanigera*). See page 113. *a*, excrescence upon the root; *b*, the lice at work; *c*, a louse much magnified.

Fig. 4.—Pear-blight beetle or shot-borer (*Xyleborus pyri*). See page 112.

Fig. 5.—Work of the pear-blight beetle.

(Figs 4 and 5 after Howard).

PLATE III.

Fig. 1.—Oyster-shell bark louse (*Mytilaspis pomorum*). See page 110. *a*, egg; *b*, female louse; *c*, *d*, *e*, *f*, stages in the life history; *g*, under side of female scale,—all much magnified.

Fig. 2.—Oyster-shell bark louse. Scales in place upon the bark.

Fig. 3.—Lesser apple leaf folder, (*Teras minuta*). See page 117. *a*, larva; *b*, pupa; *c*, moth; *d*, case made on apple leaf. (After Smith).

Figs 4 and 5.—Oblique-banded leaf roller (*Cacæcia rosana*). See page 116.

Fig. 6.—Bud moth (*Tmetocera ocellana*). See page 114. (Cornell Expt. Sta., Bulletin 50).

PLATE IV.

Fig. 1.—Forest tent caterpillar (*Clisiocampa disstria*). See page 118. *a*, egg clusters; *b*, moth; *c* and *d*, eggs; *e*, caterpillar.

Fig. 2.—Apple tree tent caterpillar (*Clisiocampa Americana*). See page 120. *a* and *b*, larvæ; *c*, egg cluster; *d*, pupa; *e*, male moth; *f*, female moth.

PLATE V.

Fig. 1.—Fall web worm (*Hyphantria cunea*). See page 121. Moths and cocoons—natural size. (After Howard. Farmer's Bulletin 99, U. S. Dept. Agr.)

Fig. 2.—Fall web worm. *a*, light form of full-grown larva; *b*, dark form of same; *c*, pupa; *d*, spotted form of moth (compare fig. 1), all slightly enlarged. (After Howard. Farmer's Bulletin 99, U. S. Dept. Agr.)

PLATE VI.

Fig. 1.—Lime tree winter moth (*Hybernica tillaria*). See page 123. *a*, larvæ at work; *b*, female moth; *c*, male moth.

Fig. 2.—Apple leaf bucculatrix (*Bucculatrix Pomifoliella*). See page 125. *a*, cocoons, natural size; *b*, same, enlarged; *c*, moth, enlarged.

Fig. 3.—Apple tree aphid (*Aphis mali*). See page 129. *a*, female; *b*, male; *c*, male, natural size.

Fig. 4.—Fall canker worm (*Anisopteryx pometaria*). See page 128. *a*, male moth; *b*, female moth; *d*, egg cluster.

Fig. 5.—Fall canker worm,—eggs and larva. *a* and *b*, egg, enlarged; *c*, segment of larva enlarged; *e*, egg cluster; *f*, full grown larva.

PLATE VII.

Fig. 1.—White-marked tussock moth (*Orgyia leucostigma*). See page 126. *a*, larva; *b*, female pupa; *c*, male pupa; *d*, *e*, male moth; *f*, female moth; *g*, same, ovipositing; *h*, egg mass; *i*, male cocoons; *k*, female cocoons, with moths carrying eggs—all slightly enlarged. (After Howard. Farmer's Bulletin 99, U. S. Dept. Agr.)

Fig. 2.—Codling moth (*Carpocapsa pomonella*). See page 133. *a*, fruit showing work of larva; *b*, point of entrance; *c*, larva, full grown; *d*, pupa; *f*, *g*, moth; *h*, head of larva; *i*, cocoon. (After Riley).

Fig. 3.—Plum curculio (*Conotrachelus nenuphar*). See page 134. *a*, larva; *b*, chrysalis; *c*, beetle; *d*, beetle and its work—all except *d*, enlarged.

PLATE VIII.

Fig. 1.—Apple maggot (*Trypeta pomonella*). See page 136. Mature fly (female), much enlarged.

Fig. 2.—Apple maggot. Larva much enlarged.—The short line above shows the natural size.

Fig. 3.—Apple maggot. An infested fruit.

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